

A NEW SECTION AND SUBSPECIES OF CALANDRINIA (PORTULACACEAE)

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ABSTRACT. Calandrinia sect. Pachypodae, sect. nov., is proposed to distinguish two species (C. galapagosa and C. pachypoda) that possess unique pollen, seed, and capsule morphology. Calandrinia pachypoda is subdivided into subspecies pachypoda and subsp. eyerdamii (subsp. nov.) based on differences in flower, seed, and androecium morphology.

Calandrinia H.B.K. contains about 130 species. The genus is distributed in two areas of the world; the western Americas and Australia. The majority are found in western South America (especially Chile), with only four species occurring in western North America and 30 species in Australia.

There have been two major taxonomic treatments of Calandrinia. Reiche (1897, 1898) assigned the species of Chile to two subgenera and twelve sections. Von Poellnitz (1934) assigned the Australian species to eight sections. A biosystematic study of the Australian species is now in progress (Carolin and West, personal communication). Kelley (1973) evaluated the sectional composition of Calandrinia in its entirety using morphological (especially seed and trichome) characters and palynological evidence. All American species except two were assigned to the sections created by Reiche (1897). Calandrinia galapagosa St. John and C. pachypoda Diels were distinct among the American species in pollen, seed, and capsule morphology (table 1).

All American species except Calandrinia galapagosa and C. pachypoda have either 3-zonocolpate or 12(15)-pantoporate pollen (Kelley 1973). The two unique species are 25(30)-pantoporate (fig. 1). Many authors treat pollen with more than six apertures as poly-pantoporate (e.g. Moore and Webb 1978; Reitsma 1970). This practice often combines different pollen types, and this is clearly the case in Calandrinia, where there is a sharp distinction between 12(15)- and 25(30)-pantoporate types (Kelley 1973).

Capsule morphology in these two species is also distinct in being subglobose, lustrous-yellow, and cartilaginous. In both Calandrinia galapagosa and C. pachypoda the seeds are dark brown, shining, and finely reticulate. Seed surface morphology is also atypical for the genus (Kelley 1973) in having a fine reticulate-areolate pattern on the surface. In specimens of C. galapagosa and C. pachypoda from Bolivia seeds have this pattern on a smooth surface. Calandrinia pachypoda specimens from Peru

have seeds with papillae on the entire surface or restricted to the margin. Seed morphology has been shown to be especially useful for species recognition in this genus (Reiche 1897; Kelley 1973). Figures 2-4 show seed morphology of these species.

Morphological, palynological, and habitat characters of these two species are summarized in table 1. Recognition of a new section of Calandrinia is supported by a distinct combination of pollen, seed, and capsule characters. Additionally, C. pachypoda is divided into two subspecies based on morphological (i.e. seed morphology, stamen number, petal color), geographical, and ecological distinctions.

TAXONOMIC TREATMENT

The taxa listed in table 1 may be distinguished by the following key.

- a. Stamens 12-15, plants endemic to Galapagos Islands
 - 2. C. galapagosa
- a. Stamens 30-100; plants of South America b
- b. Petals white; stamens 30-60; seeds papillate
 - 1a. C. pachypoda subsp. pachypoda
- b. Petals purple; stamens 80-100; seeds not papillate
 - 1b. C. pachypoda subsp. eyerdamii

Calandrinia section Pachypodae W. A. Kelley and J. R. Swanson, sect. nov. Type: C. pachypoda Diels, Bot. Jahrb. Syst. 37:399, 1906. Photograph of holotype: US!, F!; isotype: GH!.

Herbae perennes succulentae; folia linearia vel oblanceolata; inflorescentia cymosa; pollinis granula 25(30)-pantoporata, aperturis granulatis; capsula trivalvata, subglobosa, nitida-luteola, cartilaginea; semina atrobrunnea, nitida, testa subtiliter reticulata-areolata, laevi vel papillosa.

Fleshy, perennial herbs; leaves alternate herbaceous or succulent, linear or oblanceolate; inflorescence a cyme; sepals 2; petals 5, white or deep purple; stamens numerous (12-15 or 30-100); pollen 25(30)-pantoporate with scattered granulation within the aperture, 70-75 μm diameter; fruit a many-seeded subglobose capsule, lustrous-yellow, trivalvate, cartilaginous; seeds dark brown, shining, reticulate-areolate, with or without secondary papillae.

This section contains two species, C. galapagosa St. John and C. pachypoda Diels. The distribution of the species assigned to this section is shown in figure 5.

1. Calandrinia pachypoda Diels, Bot. Jahrb. Syst. 37:399, 1906. ---
TYPE: Peru, Pacasmayo a Chepen, Feb 1905, Weberbauer 4816
(photograph of holotype: F!, US!; isotype: GH!).

Woody spreading perennial; stems succulent when young, leafy most of the year, 7-15 mm in diameter; leaves 7-8 cm long, obovate, herbaceous or succulent; inflorescence 3-4 flowered; sepals subovate, acuminate, 5 mm long, 3 mm wide; petals white or purple, 10 mm long; stamens 30-100.

- 1a. Calandrinia pachypoda Diels subsp. pachypoda

Spreading perennial herbs, becoming woody at base with age; leaves herbaceous, oblanceolate or obovate; petals white; stamens 30-60; seeds brown, with papillae on margins or over entire surface. Western Peru on rocky slopes near the coast at 800-900 m (fig. 5).

Representative specimens. PERU. Jusin, 1904-1914, Weberbauer 5280 (F); Chosica, March 11-13, 1923, MacBride 2875 (US).

- 1b. Calandrinia pachypoda Diels subsp. eyerdamii W. A. Kelley and J. R. Swanson, subsp. nov. Type: Bolivia, Dept. Cochabamb, Mar 17, 1939, W. J. Eyerdam 24876 (holotype: UC!; isotype: F!, K!).

Herbae perennes succulentae; folia oblanceolata vel obovata; petala atropurpurea; stamina 80-100; semina laevia, brunnea, striata, reticulata-areolata.

Fleshy perennial herbs, becoming woody at base with age, leaves herbaceous or succulent, oblanceolate or obovate; petals deep purple; stamens 80-100; seeds brown, striate with finely elongate reticulations, papillae lacking. Central Bolivia at 2700 m associated with cacti (fig. 5).

This subspecies is distinguished from subsp. pachypoda by its deep purple flowers, very numerous (80-100) stamens, and smooth seeds. It is named in honor of Walter J. Eyerdam for his extensive field studies in South America (Goodspeed 1961).

2. Calandrinia galapagosa St. John, Amer. J. Bot. 24:95, 1937. ---
TYPE: Galapagos Islands, Chatham Island, Feb 8, 1906, Alban Stewart 1151 (holotype: BISH!; isotypes: CAS!, US!).

Perennial herb, very succulent, about 2 dm height; leaves alternate, succulent, linear, 3-6 mm long; cymes 25-35 mm

long, several-flowered; peduncle 8-16 mm long, fleshy; bracts ovate; pedicles 6-14 mm long; sepals 4 mm long, entire, obovate; petals obovate, 9-11 mm long, white to pink; stamens 12-15; style 4-6 mm long; stigma 3-lobed; capsule 4-5 mm in diameter, globose, yellow, cartilaginous; seeds 1-1.5 mm in diameter, smooth, but finely elongate-reticulate. Chatham Island, low bushes on lava near shore, Sappho Cove (fig. 5).

DISCUSSION

Calandrinia sect. Pachypodae appears to be a natural assemblage of closely related species as shown by similarity in pollen, seed, and capsule morphology. On the basis of floral and vegetative morphology as well as pollen wall ultrastructure (unpublished TEM studies) these species definitely belong in Calandrinia.

St. John (1937) suggested a possible relationship of Calandrinia galapagosa to members of sect. Dianthoideae Reiche. However, species assigned to sect. Dianthoideae have 3-zonocolpate pollen 34-40 μ m in diameter (Kelley 1973). The 25(30)-pantoporate pollen of C. galapagosa and C. pachypoda is 70-75 μ m in diameter. Species of sect. Pachypodae appear more closely related to members of the sect. Acaules Reiche, which have 12(15)-pantoporate pollen 70 μ m in diameter (e.g., C. acaulis H.B.K.).

We are aware that this taxonomic treatment is based on few specimens. Calandrinia galapagosa is known only from the type locality and a survey of North American herbaria showed no accessions of C. pachypoda not previously cited by Kelley (1973). The inability to receive loans from South American herbaria precluded examination of additional specimens. Recognition of sect. Pachypodae and elucidation of the bimodal nature of C. pachypoda will bring to the attention of our South American colleagues a species complex in need of additional collection and study. With so little known currently about the distribution and biosystematics of C. pachypoda subsp. eyerdamii, the authors believe its uniqueness should be recognized at the subspecific level at this time. Additional collections and evaluation of this taxon may eventually support treating it at the species level.

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Table 1. Comparison of Calandrinia sect. Pachypoda species

Characters	<u>C. galapagosa</u>	<u>C. pachypoda</u> subsp. <u>pachypoda</u>	<u>C. pachypoda</u> subsp. <u>eyerdamii</u>
Petal Color	pink-white	white	deep purple
Stamen#/ flower	12-15	30-60	80-100
Pollen	25(30)- pantoporate 70 μ m dia.	25(30)- pantoporate 75 μ m dia.	25(30)- pantoporate 75 μ m dia.
Seeds	brown, primarily reticulate- areolate, and smooth	brown, primarily reticulate- areolate, and papillate	brown, primarily reticulate- areolate, and smooth
Habitat	lava fissure sea-level	stony coastal slopes 800-900m	cactus hillside, 2700m

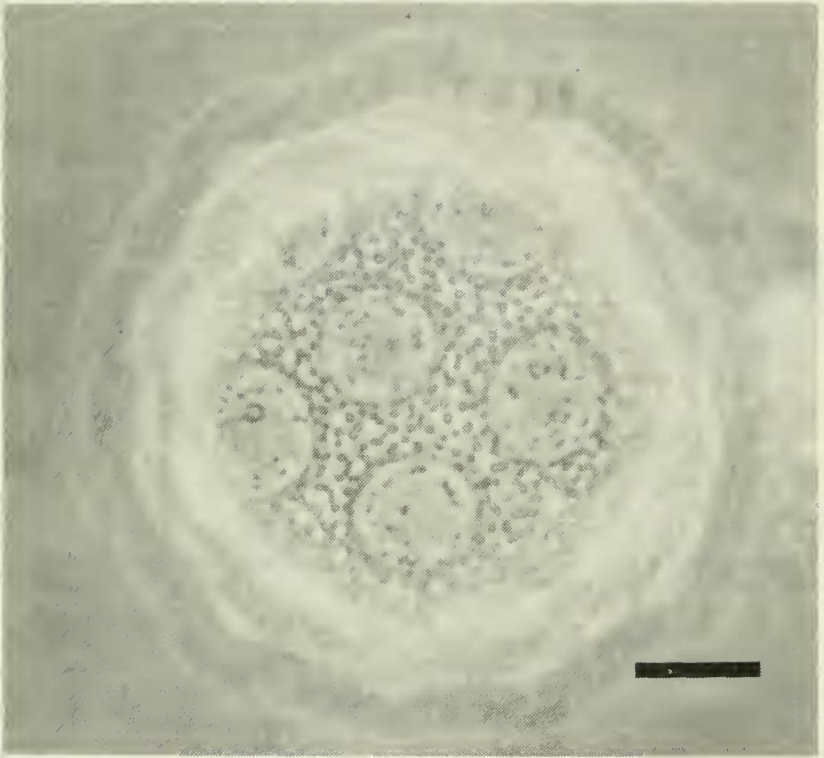


FIGURE 1. Phase contrast photomicrographs of pollen of Calandrinia sect. Pachypodae. Bar = 15 μ m.

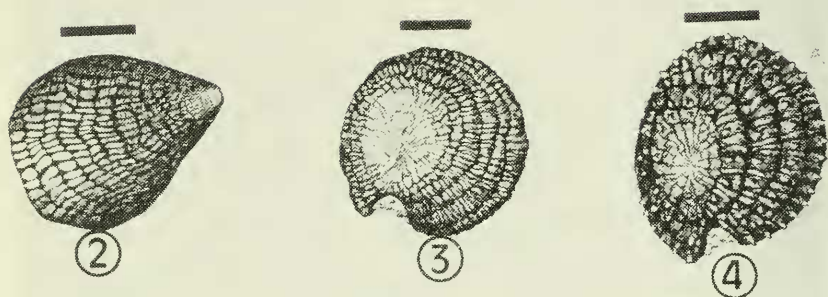


FIGURE 2-4. Seeds of *Calandrinia* sect. Pachypodae. 2. C. galapoagosa. 3. C. pachypoda subsp. eyerdamii 4. C. pachypoda subsp. pachypoda. Bar = .34 mm.

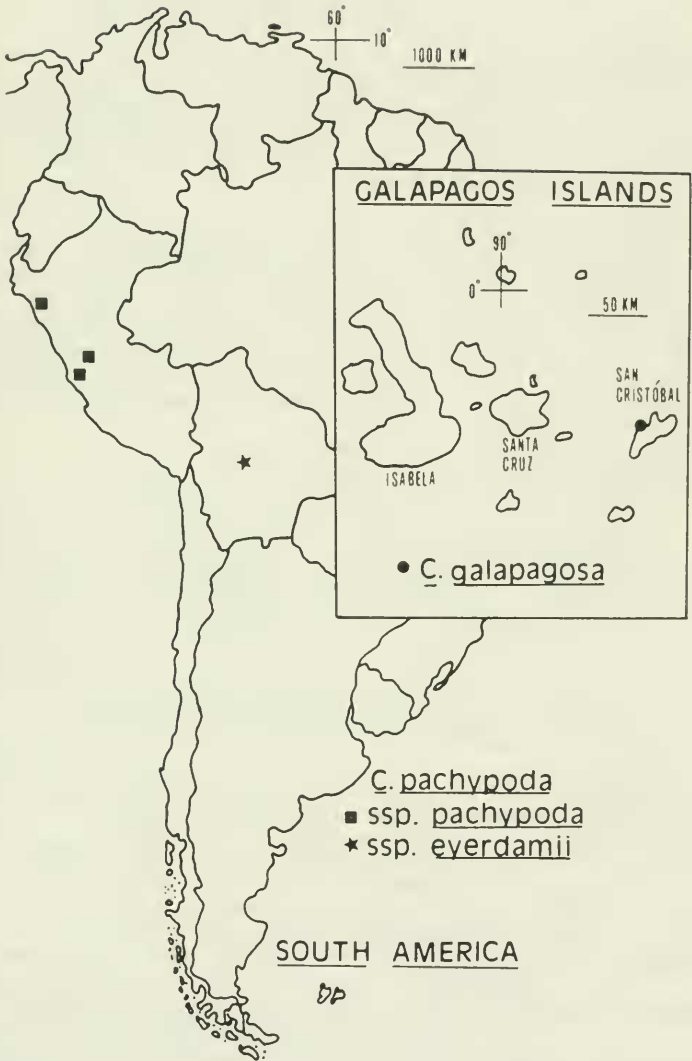


FIGURE 5. Distribution of *Calandrinia* sect. *Pachypodae*.